**Math 110 Sec**


Midterm 3
November 30, 2004
Instructor: Charles Cuell

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All solutions are to be presented on the exam paper in the space provided. A disorganized or messy solution will result in a mark of zero for that question. Time for the exam is **80 minutes**.

(1) Compute the following. 1 mark each.

(a) $\cos(-\frac{3\pi}{4})$

$= -\frac{1}{\sqrt{2}}$

(b) $\sin(\frac{7\pi}{3}) = \frac{\sqrt{3}}{2}$

(c) $\cot(\frac{11\pi}{6}) = \frac{1}{\sqrt{3}}$

(d) $\csc(\frac{3\pi}{2})$

$= 0$

(2) Find the solution sets for the following. 1 mark each.

(a) $x^2 - 2 > 7$

$\{x \in (-\infty, -3) \cup (3, \infty)\}$

$x^2 - 2 - 7 > 0$

$x^2 - 9 > 0$

$(x+3)(x-3) > 0$

(b) $\sin 2x + \sin x = 0$, on $[0, 2\pi]$.

(3) Compute the following limits. If the limit does not exist, explain why. 1 mark each.

(a) $\lim_{x \to 1^+} \log_5(x-1)$

Does not exist because $\log_5 0$ doesn't exist

$\log_{10} 100 = 2$

$10^2 = 100$

inside

(b) $\lim_{x \to 0} \frac{1}{2-e^x}$ $= \frac{1}{2-e^0} = \frac{1}{2-1} = 1$

(4) Compute the derivatives of the following functions. 1 mark each.

(a) $f(x) = \pi x^4 + x^e + 1$

$f'(x) = 4\pi x^3 + ex^{(e-1)} + 0 = 4\pi x^3 + ex^{(e-1)}$

(b) $f(x) = 3^x + \log_3 x$

$f'(x) = \ln 3 + \frac{1}{x \ln 3}$

(c) $f(x) = \cot x$ $f'(x) = -\csc^2 x$

(d) $f(x) = (x^2+1)^{101}$

$f'(x) = 101(x^2+1)^{100}\, 2x$

$= 202x(x^2+1)^{100}$

(5) Find the derivative of $r(\theta) = \cos(\sec(\sin\theta))$. 2 marks.

$r'(\theta) = -\cos\left(\sec(\cos\theta)\ \tan(\cos\theta)\cdot\sin\theta\right)(\sec(\sin\theta))$

X

(6) Find the second derivative of $f(x) = e^{2x}\cos x$. 2 marks.

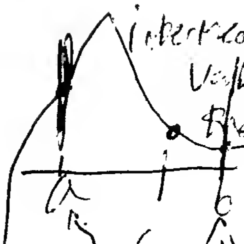
$f'(x) = e^{\ln 2x}(-\cos x)$

X − 4

(7) Find the absolute maximum and minimum of $f(x) = x^2 + x$ in the interval $[-1, 1]$. First, justify the fact that such points exist by using the appropriate theorem. *That is, name the theorem and show that it applies to this function.* ?

Not the fin..

intermediate Value theorem



$x(x+1)$ → $f'(x) = 2x+1$

$x = \frac{-1}{2}$

x − − − − 0 + + + +

x+1 − − 0 + + + + + +

−1 0

+ 0 − 0 +

$f(-1) = (-1)^2 + (-1) = 0$

$f(0) = 0 + 0 = 0$

$f(1) = 1 + 1 = 2$

$f\left(\frac{-1}{2}\right) = \frac{1}{4} + \frac{-2}{4} = \frac{-1}{4}$

Abs min: $\left(\frac{-1}{2}, \frac{-1}{4}\right)$

Abs max: $(1, 2)$

(8) Find the dimensions of a rectangle of area $100\text{cm}^2$ with the smallest possible perimeter.

$A = L \cdot W \quad = 100 = L \cdot W$

$A = 10 \cdot 10 = 100\text{cm}^2 \quad P = 2L + 2W \qquad W = \frac{100}{L} \qquad = W = \frac{100}{10}$

$W = 10$

$P = 2(10) + 2(10) = 40\text{cm}$

$P = 2L + 2\left(\frac{100}{L}\right)$

$= 2L + \frac{200}{L}$

$= 2L^2 + 200 \qquad 2L^2 = 200 \qquad \sqrt{L^2} = \sqrt{100} \qquad L = \pm 10$

can't be minus.

(9) Suppose a particle moves along the curve $y = 1 + x^2$. If $\frac{dy}{dt} = 1\text{m/s}$, what is $\frac{dx}{dt}$ when $x = 1$ m.

$y = 1 + x^2$

$\frac{dy}{dt} = 2x \frac{dx}{dt}$

$1 = 2x$

$\frac{1 = 2 \frac{dx}{dt}}{2}$

$\frac{dx}{dt} = \frac{1}{2}$